DOCUMENT RESUME

ED 268 288 CE 044 098

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TITLE Implementation of Advanced Health Care Technology into Existing Competency-Based Health Care Program. Final Report.
INSTITUTION North Schuylkill Area Vocational-Technical School, Frackville, Pa.
SPONS AGENCY Pennsylvania State Dept. of Education, Harrisburg. Bureau of Vocational and Adult Education.
PUB DATE 20 Aug 85
NOTE 68p.
PUB TYPE Reports - Descriptive (141) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Allied Health Occupations Education; Allied Health Personnel; Behavioral Objectives; *Biomedical Equipment; *Computer Literacy; *Curriculum Development; *Equipment Utilization; Learning Activities; Medical Services; Secondary Education; *Technological Advancement

ABSTRACT

A project was undertaken to develop new curriculum materials that could be incorporated into an existing health assistant program to cover recent advances in health care technology. Area physicians' offices were toured and meetings were held with administrators of local hospitals in order to discover what kinds of advances in health care technology were in use locally. Next, equipment and instructional materials were developed to update health services training in the following areas: using computers, word processing, using electrocardiography equipment, and implementing blood-drawing and blood analysis techniques. In addition, courseware was obtained to supplement existing training in such areas as venereal disease, drugs, birth defects, health maintenance, nutrition, and typing and word processing skills. The bulk of the report consists of project-developed learning guides dealing with: mounting an electrocardiogram; performing blood sugar testing; assisting a physician in detecting and assessing heart muscle damage; analyzing blood; performing cholesterol, hemoglobin, blood glucose, and prothrombin time tests using the latest equipment; and mastering venipuncture. Each guide contains some or all of the following: task and purpose statements, a terminal performance objective, safety factors, a list of equipment and supplies needed, a performance guide, related information, a student assignment, vocabulary, review questions, and an instructor checklist. (MN)

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FINAL REPORT

IMPLEMENTATION OF ADVANCED HEALTH CARE TECHNOLOGY INTO EXISTING COMPETENCY-BASED HEALTH CARE PROGRAM

Contract Number: 93-5008

By: Shirley Klemovage

North Schuylkill Area Vocational-Technical School
Frackville, Pennsylvania 17931

August 20, 1985

PENNSYLVANIA DEPARTMENT OF EDUCATION

BUREAU OF VOCATIONAL EDUCATION

VOCATIONAL PROGRAM SUPPORT SERVICES SECTION

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PREFACE

The various types of medical equipment chosen for integration into the existing Health Assistant Program were chosen following an inspection of medical clinics, doctor's offices, and hospital satellites located in the immediate area. The craft advisory committee was then consulted for final approval.

Instructor training was facilitated through the co-operation of the Good Samaritan Hospital, Pottsville, PA and by utlizing the expertise of other health professionals.

93-5008: Implementation of Advanced Health Care Technology Into Existing Competency-Based Health Care Program

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$6,000 Federal

7/01/84 to 06/30/85

The purpose of this project was to explore and develop new curriculum materials in the area of advanced technology in the Health Assistant Program.

Objectives:

1. To implement a program to integrate computers in the classroom in the preparation for Health Unit Coordinators.
2. To implement the necessary competencies required for Health Assistant students to become multi-purpose medical technology equipment operators.
3. To provide training resources in local health care units.

Outcomes:

1. A task analysis of the curriculum needed to implement advanced technology in health careers concerning the projects stated objectives was developed.
2. The necessary instructional materials were obtained or developed.
3. Local craft advisory committee and neighborhood health care facilities played an active role in validating and assisting in the implementation of the new curriculum.

Audience:

The resulting reports and curriculum materials are useful to the Bureau of Vocational Education, vocational educators and curriculum developers.

Published Materials:

Final Report
Copies of various task packages

Background

The impact of technology in health careers has led to increased complexity in health care to patients. The rapid introduction of technologies has resulted in obsolescence in the hospital physical plant, space usage, machinery, health professional skills and indeed in all institutional arrangements. The effort to keep pace with innovation has increaed the complexity, not only of clinical services but also of the ancillary departments.

The technological specializations within hospitals has had a ripple effect on related health care services, such as clinics and home care agencies. The high cost of hospital care has meant that more and more services must be offered through ambulatory clinics, which have had to specialize to meet these needs. For example, specific skills need to be taught concerning the operation of highly sophisticated medical devices such as blood chemistry and hemotology systems, the coagulation unimeter and the electrocardiogram machine.

Academic computing is a billion dollar business, however, health education has made very little use of this tool. In a recent survey of university and college health programs, 61% reported that they made no use of computers in their department. Only 18% of the programs reported using computers for instructional purposes; 11% used computer assisted instruction and 4% used computer simulations.

This program will focus upon curriculum utilization with the computer as a potential aid to instruction, both as a motivational device and as a device for allowing the student to apply knowledge to

hypothetical problems, such as computerized dietary analysis models. this will allow the student to input information concerning what they eat (including the so called "fast-foods") and receive in return some output which identifies how well they have met the standards of a well-balanced diet. By developing student interest, such programs can provide an excellent introduction to the study of nutrition. Such techniques can be developed to focus on other areas in health such as body structure and function and medical terminology.

The student can also be given a chance to apply his or her knowledge to the solution of realistic problems through computer simulation games. When presented with a hypothetical problem regarding first-aid, health care, diet, etc., the student will select among various options for dealing with the problem.

Of special importance is the implementation of those computer-assisted functions necessary to perform the role of Health Unit coordinator. Curriculum utilization will focus upon the coordinators duties such as filing and retreiving patient records, ordering tests and medications, and patient teaching programs.

Methods

As new specialized services are added to health care units, workers must be taught new skills to meet their demands. In order to implement this highly sophisticated segment of health into the existing program, competencies needed to be identified and developed and a possible sharing of neighborhood health care resources utilized in an effort to train the students.

The initial step in the project was to determine what qualifications would be necessary and what equipment a Health Assistant student should be proficient in operating in order to be employable as a multi-purpose technician or health unit coordinator. This was accomplished by securing permission from area doctors to tour their clinics for the purpose of checking out the special equipment in use. Visitations were also made in the company of a medical and surgical supply representative to determine the most commonly used types of high technology equipment in use outside of the hospital setting. Meetings were held with the assistant administrators of local hospitals to discuss necessary employable skills and to secure assurance of using special hospital areas for training purposes.

Following consultation with the craft advisory committe the equipment purchased included:

Electrocardiogram machine
Apple Computer
Coagulation unimeter
Hycel Counter 555
Unimeter 300
Accu-chek b G blood glucose monitor
Electronic blood pressure unit
Electronic thermometer
Veniform teaching model

In order to become knowledgeable about and proficient in the operation of the newly acquired equipment, the instructor utilized the following regimen:

Attended adult evening courses at AVTS for Basic Computer I and II.

Attended one week word processing training sessions at AVTS.

Received electrocardiography training in Technical Services Department, coronary care unit and intensive care unit of Good Samaritan Hospital.

Received instruction in blooddrawing techniques, preparation of blood specimens, and obtaining prothrombin times, blood chemistry determinations, red and white blood cell counts using computerized laboratory equipment from medical technology consultant.

Workshops attended were as follows:

"Introduction to Microcomputer Use in Client and Staff Health Promotion and Education", sponsored by the Milton S. Hershey Medical Center at the Pennsylvania State University Capitol Campus.

"The Health Care Professional of the Future", sponsored by Region II - ASHET.

"12 Lead E.K.G. Interpretation", sponsored by the Lehigh Valley Hosptial Center.

"Cancer Up-Date", sponsored by the Schuylkill Unit-American Cancer Society.

"Infection Control for the Home Health Patient", sponsored by the Milton S. Hershey Medical Center.

Visits were made to three schools (Central Montgomery County A.V.T.S., Norristown, Pa.; Swenson Skills Center, Philadelphia, Pa.; Randolf Skills Center, Philadelphia, Pa.) for the purpose of:

(a) touring health occupations areas

(b) discussion of health programs

(c) gather information regarding laboratory assisting programs

(d) review curriculum

ANALYSIS

A task analysis of the curriculum needed to integrate advanced technology into the Health Assistant Program was completed and "mini-mods" for each task developed. A list would include:

1. Record an electrocardiogram

2. Mount an electrocardiogram (Note: The electrocardiogram is no longer simply the tool of the EKG technician. It is commonplace in ambulatory clinics and doctor's offices)

3. Perform blood sugar testing with accu-check bG blood glucose monitor. (Note: The high incidence of diabetes mellitus in Schuylkill County makes this item a high priority for patient teaching.)

4. Perform a red blood count, white blood count, hemoglobin, and mean corpuscular volume using the Hycel Counter 555. (Note: Computerized blood counting is now being done "on the spot" rather than send patients to the hospital laboratory. Sufficient blood for testing can be obtained by finger puncture and a trained laboratory technician or medical technologist is not needed - just someone taught the proper procedure).

5. Perform cholesterol test using the unitest system.

6. Perform hemoglobin test using the unitest system.

7. Perform blood glucose test using the unitest system. (Note: Becoming increasingly popular in doctor's offices, the unitest system can offer fast results for twenty-four different blood tests. Again, the necessity to travel to the hospital and wait several days for results is eliminated. Again, laboratory personnel is not required. Although blood must be obtained by venipuncture, the students may use control samples or a sample obtained by the instructor.)

8. Perform venipuncture. (Note: Proper techniques for this procedure is taught by using a venipuncture teaching model.)

Through the use of co-operating neighborhood resources, other skills could be taught such as electroencephalogram or pulmonary function equipment operators, which would prove too costly to attempt to teach in the school atmosphere. Also, although the need exists for special equipment operators, the demand is not sufficient to justify the expense involved in many instances.

A program was implemented to integrate computers into the classroom setting. A variety of curriculum software was obtained:

I. Instructional Aides
- Heart Lab
- Reproduction Organs
- Circulation System
- Senses
- Your Body Series I and II
- The Ear
- Human Body: An Overview
- Medical Terminology Comptency Tests I, II and III
- The Eating Machine

II. Tutorial Programs

- Reproduction Process
- Venereal Disease
- Consumer's Guide to Prescription and Non-Prescription Drugs
- Drugs
- Elements of Medical Terminology
- Computing Your Way to Better Nutrition
- Prenatal Baby Care
- New Baby Care
- Birth Defects: Causes
- Birth Defects: Types
- Birth Defects: Detection
- Pregnancy and You
- Banks Street Writer
- Mastertype

III. Simulation Games

- Biology #1
- Human Systems Keyword
- Microbe
- Nutri-Venture
- Snackmaster
- Health
- The Doctor Game
- Psychology

CONCLUSIONS AND RECOMMENDATIONS

This newly implemented curriculum could provide a unique approach to the impact of technology in health careers in Pennsylvania. The necessary competencies were identified and implemented for Health Assistant students to become multi-purpose medical technology equipment operators. A program was implemented to integrate computers in the classroom in preparation for Health Unit Coordinators. In addition, neighborhood health care facilities played an active role in validating and assisting in the implementation of the new curriculum. Interest was greatly simulated in those students already enrolled.

DISSEMINATION

Any curriculum developed as a result of this project will be available through VEIN.

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A LEARNING GUIDE

TASK: MOUNT AN ELECTROCARDIOGRAM

PURPOSE: TO PROVIDE A RECORD FOR EVALUATION BY THE PHYSICIAN.

TASK: MOUNT AN ELECTROCARDIOGRAM

Terminal Performance Objective

Given the necessary equipment and supplies, mount an electrocardiogram making sure it is neat, mounted correctly, and has correct standards in each lead.

Equipment and Supplies

Previously run electrocardiogram
Ruler - EKG
Scissors
Electrocardiogram mount

Performance Guide

1. Assemble equipment. Work on a flat surface such as table or desk.
2. Wash hands.
3. Label ECG mount with all required information. This usually requires patient's name, date, address or room number and doctor's name.
4. Unroll ECG carefully to avoid all acratches. Never fold the ECG paper. This leaves bend marks.
5. Locate lead 1. Find the correct ST'D mark. Make sure it is centered between complexes. Do the following:
   a. Position the ruler so the ST'D is centered in the middle of the length required for lead 1. If the agency/physician prefers the ST'D at the beginning of the lead, position it correctly.
   b. Use a pencil, pen, or fingernail to make a small mark on the upper margin at each end of the required length.
   c. Place the ruler vertically along the end of the required length. Hold securely and tear the paper evenly, or use scissors to cut the paper at the mark.
   d. Tear or cut the opposite end as in preceding step c.
   e. Slip the ruler into the lead slot 1 to make sure it is open and loose for slot mounts. Remove the protective covering or expose the tape or sticky surface on self-stick mounts.
   f. Fold about 1/4 inch of the paper over the end of the ruler. Hold the strip in place and slide it into the lead 1 area on the slot mount. On self-stick mounts, position the recording and press gently to the sticky surface. Check to be sure the recording is firmly attached to the mount.
   g. On slot mounts, hold the strip gently in place while removing the ruler.
   h. Check that the strip is mounted neatly, ST'D is centered and correct, complexes are clear, etc.
6. Repeat for the remaining 11 leads. Use the marked areas on the ECG ruler to determine length of each lead. Caution: Double check the lead marking to be sure each lead is mounted in its correct area.
7. Replace all equipment used.

Related Information

Over the years, electrocardiologists have built up quite a library of ECG tracings ... both from normal hearts and from abnormal or electrically defective hearts.

A multitude of names have been given to various electrical defects within the heart's conduction system and today, electrocardiology is essentially an art of pattern recognition. New tracings with unknown information contained within them are compared either empirically or analytically with previous tracings which have been analyzed on the basis of autopsy findings, surgical findings, etc.

In performing such pattern recognition, the electrocardiologist is, therefore, able to diagnose certain characteristics of the electrical conduction system of the living heart without cutting into and visibly looking at the heart.

When the physician analyzes the electrocardiogram, he looks for certain details to guide him in his diagnosis. Some of these are:

Quality of recording:

...Is the ECG clinically acceptable, with a dense, stable baseline having no AC or other interference? No ECG artefacts or tremor?

Appearance of waves:

...Are all waves present?

...Are they rounded...peaked...smooth...notched?

...Are they upright...inverted...both?

Correlation of waves:

...Do the waves have a consistent size...shape...rhythm?

...Is there an occasional or missing beat?

...Is there a normal or abnormal correlation between the different leads?

Measurement of waves:

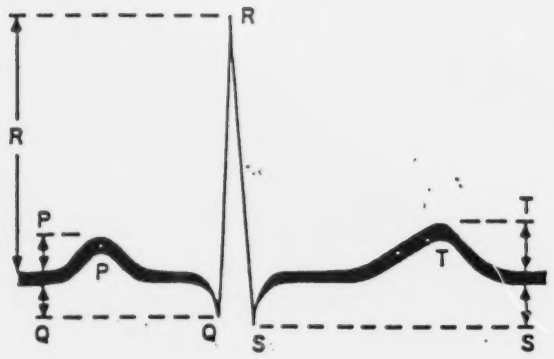
...What are peak voltages of each wave?

...What is the time interval between significant parts of the complex?

...What is the heart rate?

THE ELECTROCARDIOGRAM IS VALUABLE in the diagnosis of a wide range of cardiac conditions.

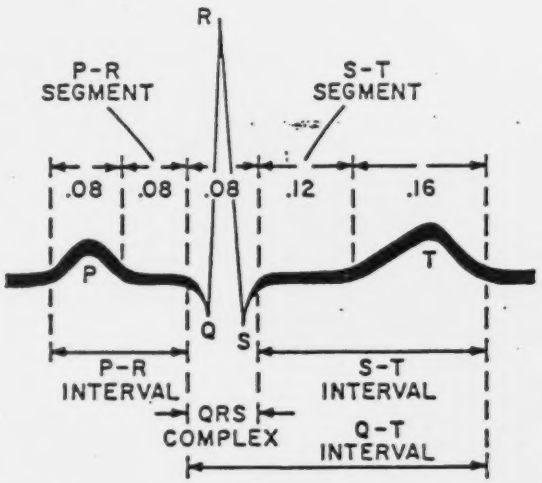
Irregular heart rhythm. The heart rate may be abnormally fast (tachycardia), at more than 100 beats per minute. Or it may be abnormally slow (bradycardia), at less than 60 beats per minute. Or the rate may change from moment to moment, as during breathing. Or there may be missing or added beats from time to time.



MEASURE FROM THE FLAT PART OF THE RECORDING, JUST BEFORE THE "P" WAVE, OR JUST AFTER THE "T" WAVE. THIS IS THE ELECTRICALLY NEUTRAL PART OF THE CARDIAC CYCLE, WHERE THE HEART IS RESTING.

MAKE UPWARD MEASUREMENTS FROM THE TOP OF THE BASELINE.

MAKE DOWNWARD MEASUREMENTS FROM THE BOTTOM OF THE BASELINE.



INTERVALS:

P-R . . . BEGINNING OF P-WAVE TO BEGINNING OF QRS COMPLEX.

S-T . . . END OF S-WAVE TO END OF T-WAVE.

Q-T . . . BEGINNING OF Q-WAVE TO END OF T-WAVE.

SEGMENTS:

P-R . . . END OF P-WAVE TO BEGINNING OF Q-WAVE.

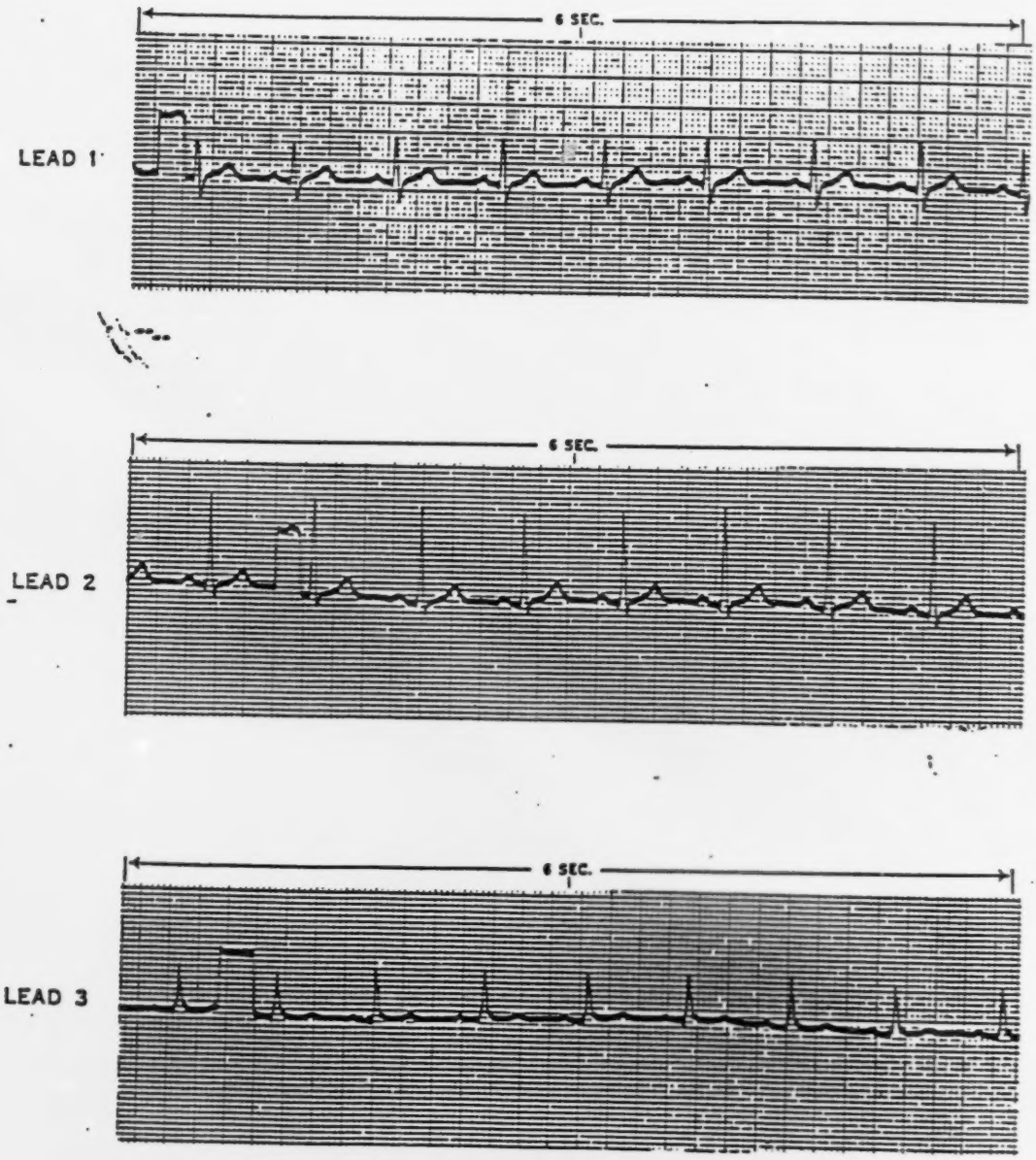
S-T . . . END OF S-WAVE TO BEGINNING OF T-WAVE.

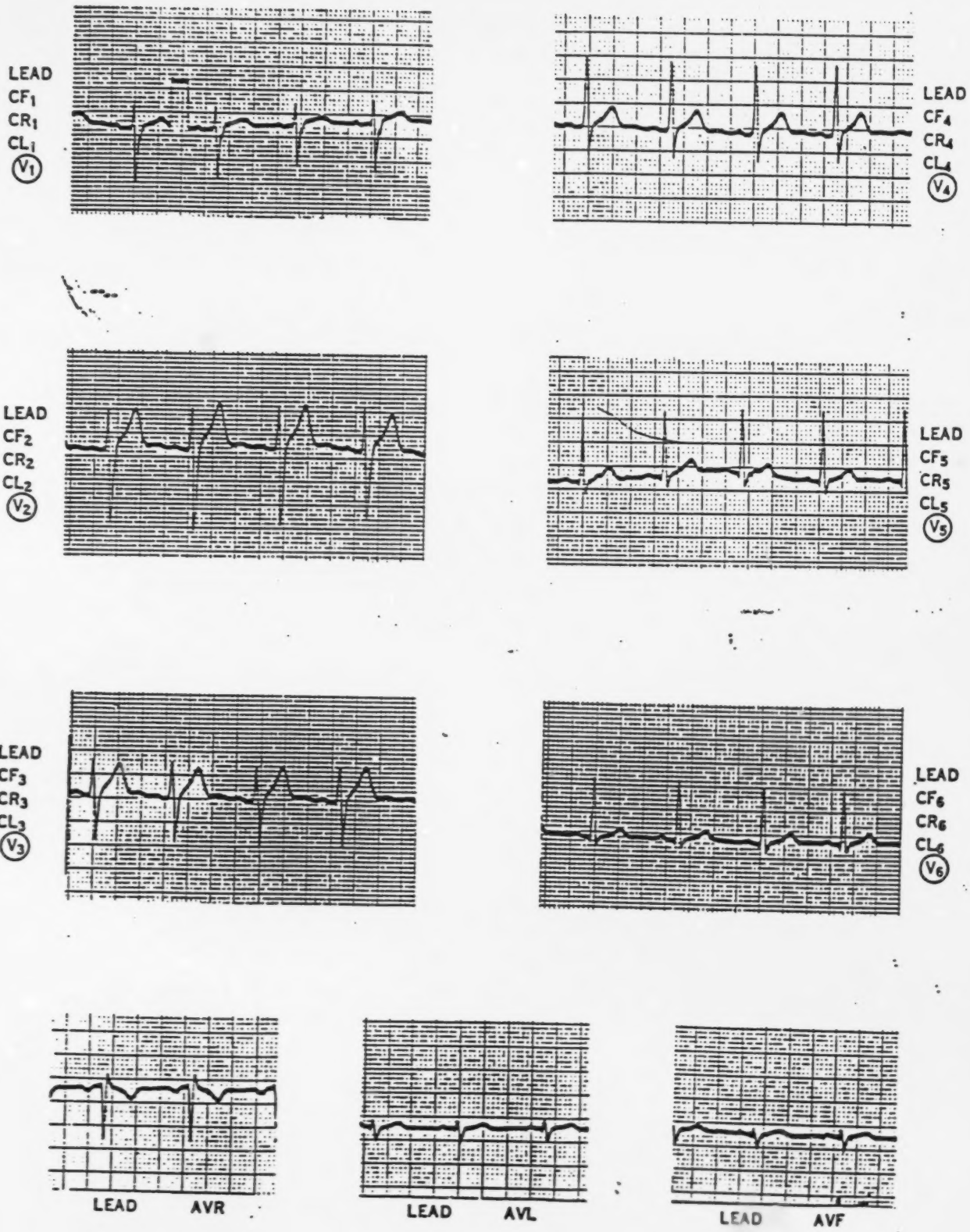
COMPLEX:

QRS . . . BEGINNING OF Q-WAVE TO END OF S-WAVE.

DURATIONS:

AVERAGE DURATIONS SHOWN ON DRAWING, IN SECONDS.


6 SEC.
LEAD 1
6 SEC.
LEAD 2
6 SEC.
LEAD 3


LEAD
CF1
CR1
CL1
V1
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CF4
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CL2
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CF5
CR5
CL5
V5
LEAD
CF3
CR3
CL3
V3
LEAD
CF6
CR6
CL6
V6
LEAD AVR
LEAD AVL
LEAD AVF

ASSIGNMENT

Activity:

1. Practice mounting electrocardiograms.

Questions:

1. What are artifacts?

2. What are the most common causes of artifacts?

3. How can artifacts be eliminated or minimized to insignificance?

4. What is the least common cause of artifacts?

5. Why is proper grounding of the ECG instrument important?

6. What could possibly be the problem is your recording binds, tears or shows large burns?

7. What is the proper paper speed?

8. What do you do if the ECG instrument does not respond?

INSTRUCTOR CHECKLIST: *Mounting an electrocardiogram.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled equipment.*		
2. *Labeled mount with all required information.*		
3. *Measured length of leads correctly.*		
4. *Positioned standard in each lead correctly.*		
5. *Tore or cut ends of strips neatly.*		
6. *Inserted strips in slots or securely adhered them to tape surface.*		
7. *Placed leads in correct areas.*		
8. *Avoided bend or scratch marks on paper.*		
9. *Replaced equipment.*		

***All steps must be rated acceptable**

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A LEARNING GUIDE

TASK: PERFORM BLOOD SUGAR TESTING WITH ACCU-CHEK bG BLOOD GLUCOSE MONITOR

PURPOSE: TO ASSIST PATIENT IN CONTROLLING DIABETES BY MONITORING BLOOD GLUCOSE AT HOME.

TASK: PERFORM BLOOD SUGAR TESTING WITH ACCU-CHEK bG BLOOD GLUCOSE MONITOR

Terminal Performance Objective

Given a patient and necessary supplies, collect and test a blood sample for sugar content. Results must be within 10 mg/dl of those obtained by instructor.

Equipment and Supplies

Accu-Chek bG Blood Glucose Monitor
Vial of Chemstrip bG's (you must use the vial with 50 strips)
Alcohol swab
Lancet
Finger pricking device (optional)
Dry cotton ball

Performance Guide

1. Calibrate meter as directed. Note: This step must be performed every time a new bottle of chemstrip bG 50's test strips are opened.
2. Lay an unused test strip on a flat surface with the test pads facing up.
3. Clean fingertip with alcohol swab.
4. Hold arm down to allow blood to flow to fingertips.
5. Prick the side of the fingertip using a lancet or automatic finger-puncture device.
6. Squeeze fingertip lightly until a large droplet of blood has formed.
7. Touch blood to test pads on strip making sure both yellow and white squares are covered. Do not smear blood.
8. Immediately press timer button and meter will count to 60.
9. When buzzer sounds, wipe the blood from the test pads in one motion using a clean, dry cotton ball.
10. Push black button and insert the reacted Chemstrip bG test strip under the strip guide, pads facing up. Door must remain open until the next buzzer sounds.
11. When buzzer sounds again at 120 seconds, close the door of the meter.
12. Read the blood sugar value on the display screen.
13. Record test results.
14. Press ON/OFF button to turn meter off.
15. Open door, remove test strip.

Related Information

The purpose of testing with Chemstrip bG at home is to measure the amount of blood sugar (glucose) in the blood. The results of this test help the patient know how much insulin, food, and exercise and needed to control his diabetes.

Some ways to avoid inaccurate readings:

1. Keep test strip vial capped tightly. Do not expose to heat, light, or moisture. Keep in original container.
2. Do not use strips that have passed the expiration date.
3. Do not cut or alter the strips in any way.
4. Do not smear or rub blood into the test pads.
5. Use a drop of blood large enough to cover both pads simultaneously.

To calibrate meter:

1. Carefully remove calibration strip from vial.
2. Make sure the lot number matches the vial number.
3. Calibrate meter whenever you open a new vial.
4. Open meter door.
5. Insert top of strip into slot on right side of meter.
6. Advance strip as far as it will go - about 3/4" will remain visible.
7. Push lower edge of strip forward until you hear it 'click'.
8. Close door.
9. Push ON/OFF button. The numbers 888 will appear on the screen.
10. Remove one strip from vial and recap the vial.
11. Slide unused strip under the strip guide with pads facing up.
12. Close door and 000 will be displayed on the screen
13. Open door and remove strip - use this to test glucose. Let door open.
14. The meter is calibrated and ready to test blood sugar.

The Accu-Chek bG will provide blood sugar readings between 40 and 400 mg/dl.

*If HHH appears on the display screen, the blood sugar level is over 400 mg/dl. Take the reacted strip out of the meter and compare it to the chart on the side of the chemstrip vial.

*If LLL appears on the display screen, the blood sugar level is below 40 mg/dl. Compare to color chart on chemstrip vial.

ASSIGNMENT

Activity:

1. Practice performing a blood sugar test on another student.

2. Teach patient (another student) how to test blood glucose at home.

Questions:

1. What is diabetes mellitus?

2. What is the advantage of having the patient check his own blood sugar at home?

3. Who determines how often blood sugar testing should be done?

4. By what methods does a person with diabetes control the illness?

5. Why is it important to calibrate the meter and follow directions carefully?

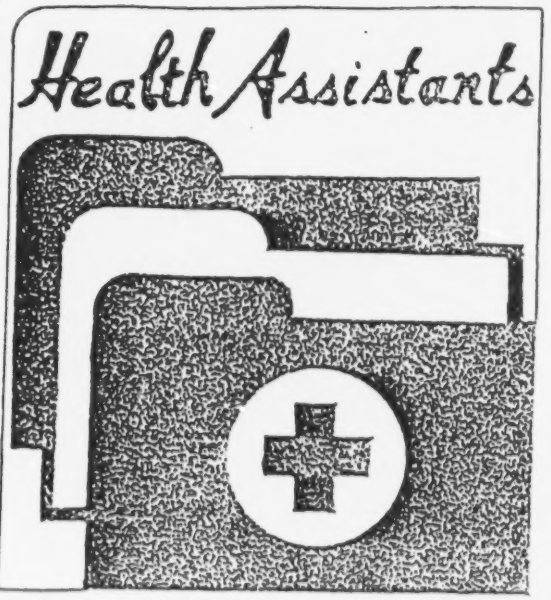
6. Where would you recommend a patient store his equipment at home?

7. What is the normal blood glucose reading?

INSTRUCTOR CHECKLIST: *Performing blood glucose testing with Accu-Chek bG monitor.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled equipment and supplies.*		
2. *Calibrated meter.*		
3. *Positioned test strip.*		
4. *Prepared fingertip.*		
5. *Pricked fingertip and applied blood to pads.*		
6. *Set timer.*		
7. *Wiped Chemstrip and inserted into meter.*		
8. *Closed door as directed.*		
9. *Read and recorded test results.*		
10. *Turned meter OFF and removed test strip.*		

***All steps must be rated acceptable**



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A LEARNING GUIDE

TASK: RECORD AN ELECTROCARDIOGRAM

PURPOSE: TO ASSIST THE PHYSICIAN IN DETERMINING THE PRESENCE OF CARDIAC ARYTHMIAS OR HEART MUSCLE DAMAGE.

TASK: RECORD AN ELECTROCARDIOGRAM

Terminal Performance Objective

Given a patient and an electrocardiogram machine, record an electrocardiogram. All criteria on the evaluation sheet must receive a satisfactory rating.

Equipment and Supplies

Bed
Electrocardiogram machine
Electro pads
Liquid ECG conductor

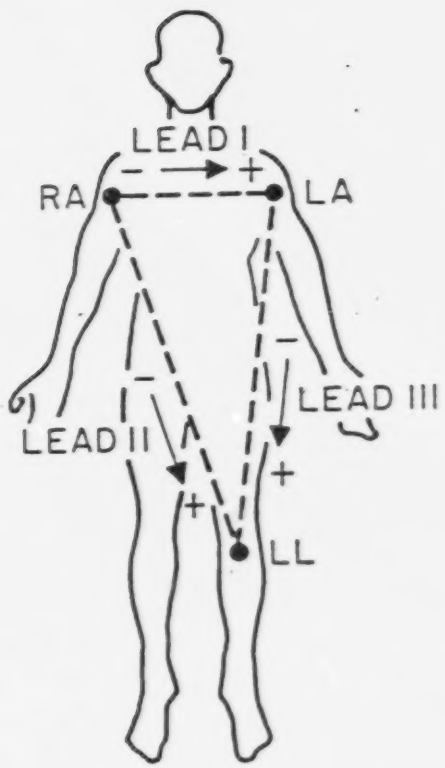
Performance Guide

1. Assemble all equipment.
2. Identify patient. Explain procedure. Avoid using words such as "electrocute". Tell patient you are recording the activity of the heart. Stress that there will be no discomfort. Explain that the patient must lie perfectly still.
3. Ask the patient to remove clothing and put on an examination gown.
4. Position patient on a firm bed or examination table. A small pillow may be placed under the head. Drape with bath blanket or sheet.
5. Position the machine in a convenient location. It may be easier to work from the left side since this is where most of the chest leads are positioned.
6. Plug in the power cord. Caution: Never use a defective cord.
7. Apply the limb electrodes to the fleshy part of the arms and legs. The pad, which increases conduction, should be beneath each electrode and the lead connector should point at the hands or feet. Fasten the straps securely but not too tight.
8. Locate the correct positions for the chest sensors and apply a dab of conductor liquid to each site. Depress the rubber bulb slightly and apply the chest sensors to the indicated areas. (Sensors are coded).
9. Turn on the main switch. Red pilot light will go on.
10. Check standardization of machine. Put lead selector on ST'D position and set record switch to Run 25. Make sure sensitivity is set at 1. Center the stylus. Momentarily press the ST'D button. Check the standard. It should be 10 small blocks or 2 large blocks high.
11. Check color of the line. It should be clearly visible but not too dark. Adjust stylus heat control if necessary.
12. Run the leads. The recording should be centered on the paper. If complexes are too small, set sensitivity at 2. If too large, set at 1/2. If complexes are too close, as in severe tachycardia, set to Run 50. Mark "Run 50" on paper to alert doctor. Be sure no artifact is present. Note: The machine codes leads automatically. Some machines require manual coding.

13. Turn power button off. Remove electrodes from patient. Wash the skin with warm water and dry thoroughly.
14. Clean electrodes well. Coil wire and replace.
15. Write patient's name, date, and doctor's name on the EKG. Roll it carefully to avoid scratches.
16. Wash hands.

Related Information

An electrocardiogram (EKG or ECG) is a picture or tracing of the electrical current in the heart. An electrode receives and conducts an electrical impulse. Using special electrodes, the electircal activity is recorded from different angles which are called leads. The different leads or angles give the physician a more complete picture of the heart. By noting an electrical disturbance in any of the leads, the physician can determine which parts of the heart are diseased or malfunctioning.



EINTOVEN TRIANGLE

LEAD ARRANGEMENT AND CODING

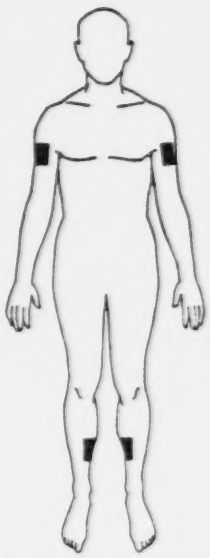
BURDICK EK-8 ELECTROCARDIOGRAPH

STANDARD LIMB LEADS

LEAD MARKING CODE	LEAD	SENSORS CONNECTED	CODE COLOR	BODY
			RL	GREEN
.	LEAD 1	LA and RA	LL	RED
..	LEAD 2	LL and RA	RA	WHITE
...	LEAD 3	LL and LA	LA	BLACK

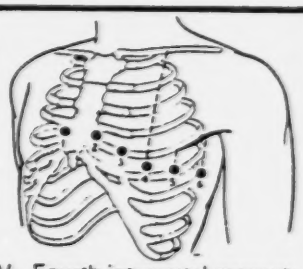
AUGMENTED LIMB LEADS

LEAD MARKING CODE	LEAD	SENSORS CONNECTED	CODE COLOR	BODY
			RL	GREEN
....	aVR	RA and (LA-LL)	LL	RED
.....	aVL	LA and (RA-LL)	RA	WHITE
.....	aVF	LL and (RA-LA)	LA	BLACK



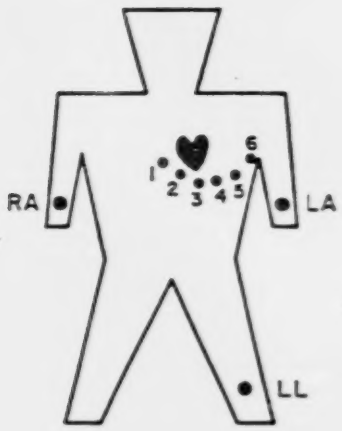
CHEST LEADS

LEAD MARKING CODE*	LEAD	SENSORS CONNECTED		CODE COLOR BODY	CODE COLOR INSERT
— .	V_1	V_1 and (LA-RA-LL)	V_1	BROWN	RED
— ..	V_2	V_2 and (LA-RA-LL)	V_2	BROWN	YELLOW
— ...	V_3	V_3 and (LA-RA-LL)	V_3	BROWN	GREEN
—	V_4	V_4 and (LA-RA-LL)	V_4	BROWN	BLUE
—	V_5	V_5 and (LA-RA-LL)	V_5	BROWN	ORANGE
—	V_6	V_6 and (LA-RA-LL)	V_6	BROWN	VIOLET

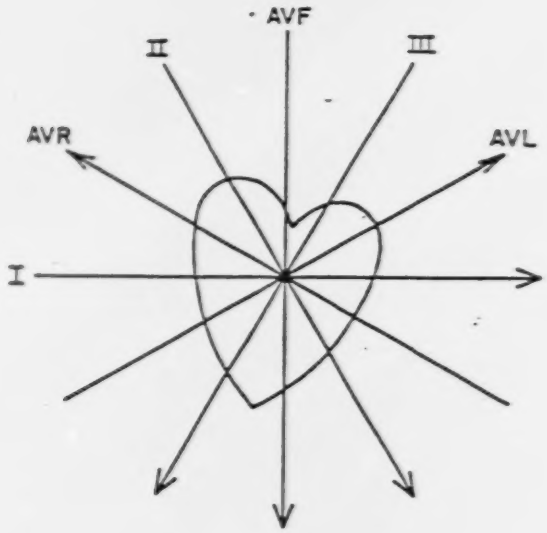


V_1 Fourth intercostal space at right margin of sternum
V_2 Fourth intercostal space at left margin of sternum
V_3 Midway between position 2 and position 4
V_4 Fifth intercostal space at junction of left midclavicular line
V_5 At horizontal level of position 4 at left anterior axillary line
V_6 At horizontal level of position 4 at left midaxillary line

*IF ½ STANDARD IS SELECTED IN THE V LEADS, ONLY THE DASH WILL APPEAR AS A DOTTED LINE: .... (½ STANDARD, V2)



After making a recording of each of these 12 electrode configurations, a cardiologist then has a typical 12 lead electrocardiogram. Each lead recording contains some information that the other 11 do not contain, and basically the heart has been "electrically looked at" from 12 different directions.



The orientation of the heart within the chest as well as countless other cardiac characteristics can be determined from these 12 recordings.

The following 12 tracings clearly show how each configuration lends different information due to the differences in voltage peaks and valleys.

ASSIGNMENT

Activity:

1. Using a student as a patient, practice recording an electrocardiogram.

Questions:

1. True or false. Electronic sophistication of the EKG instrument enables it to record cardiac voltage only.

2. True or false. Patient psychology can be more important in obtaining a diagnostically-pure EKG than the mechanics of administering the ECG.

3. Identify all possible sources of AC interference in the room in which you are now sitting.

4. Experienced electrocardiographers prefer to work at the patient's left side. Why?

5. What are leads?

6. The internationally-accepted standard of recording an ECG is at a speed of ?

7. What does the EKG record?

8. Why is it impostant to keep the sensors clean?

INSTRUCTOR CHECKLIST: Recording an electrocardiogram.

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. Assembled *equipment*.		
2. Identified patient and explained procedure.		
3. Positioned, draped and reassured patient.		
4. Attached cord		
5. Applied limb electrodes according to instructions.		
6. Attached chest sensors correctly.		
7. Turned on machine and set controls properly		
8. Recorded leads.		
9. Turned machine off.		
10. Cleansed patient's skin after removing sensors.		
11. Cleaned electrodes.		
12. Labeled and rolled E.C.G.		
13. Replaced *equipment*.		

*All steps must be rated acceptable

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A LEARNING GUIDE

TASK: PERFORM A RED BLOOD CELL COUNT (RBC), WHITE BLOOD CELL COUNT (WBC), HEMOGLOBIN (HGB), HEMATOCRIT (HCT), AND MEAN CORPUSCULAR VOLUME (MCV) USING THE HYCEL COUNTER 555.

PURPOSE: TO DEVELOP SKILL IN THE USE OF A MULTI-TEST ANALYZER AND TO ACQUIRE AN UNDERSTANDING OF THE IMPORTANCE OF BLOOD EXAMINATIONS AS AN AID TO DIAGNOSIS.

TASK: PERFORM A RED BLOOD CELL COUNT (RBC), WHITE BLOOD CELL COUNT (WBC), HEMOGLOBIN (HGB), HEMATOCRIT (HCT), AND MEAN CORPUSCULAR VOLUME (MCV) USING THE HYCEL COUNTER 555.

Terminal Performance Objective

Given a Hycel counter 555, a blood sample, and other necessary equipment and supplies, determine the red cell count, white cell count, hemoglobin, hematocrit, and the mean corpuscular volume of the sample with 100% accuracy.

Safety Factors

1. Controls must be kept refrigerated.
2. Handle all body fluids with extreme caution to avoid contamination.
3. Do not permit waste container to over-fill.Empty, rinse bottle and dry neck.
4. Flashing numbers indicate test results are not valid. Repeat test! (If it persists - run cleaning solution).
5. Clean aperature only with special camel hair brush.
6. The lysing and hemoglobin reagent contains CYANIDE which is a poison. It should not be taken internally. Wash thoroughly if it should drop on your skin.

Equipment and Supplies

Hycel counter 555
Lysing and hemoglobin reagent
Disposable blood dilution vials (cuvettes)
Hema-plus tri-level controls / Whole blood - purple top collection tube
Isotonic diluent
Detergent solution
Deproteinizing solution
Lint-free tissues

Performance Guide

1. Turn instrument on and allow 20 minutes for warm-up. Back-flush all liquid from probe transducer.
   *Start of day procedure:
   a. Place a vial containing detergent on carrier block and raise it to the up position. Run 5 counts.
   b. Prepare a double dilution of control material (or whole blood). Add 12 drops of lysing reagent.
   c. Place on carrier block and run 15 counts.
   d. Blot probe thoroughly but gently.
   e. Run 2 counts of plain diluent.
   f. Check threshold setting (5.5)
   g. Verify the HGB zero using a HGB zero solution (6 drops lysing reagent to 10 ml diluent).

Note: The probe should always be left immersed in solution except for short periods of time. After standing in detergent, run a one rinse count of plain diluent.

2. Hit diluter bar and draw blood sample. Wipe pipette tip. Dispense into cuvette, cap and mix gently. (WBC and HGB dilution). Using this dilution, draw sample by hitting diluter bar, wipe pipette, and dispense into empty cuvette. (RBC - MCV and HGB dilution).
   Note: Be careful not to cause bubbles.
3. Add lysing and hemoglobin solution to first dilution (red solution). Mix gently and wait 3 minutes. Place cuvette (with lid) on carrier block. Close door. Take hemoglobin reading. Raise carrier block, depress WBC button and take WBC reading. Record. Recheck results X3.
   Note: Handle cuvettes by rim only. HGB reading will be affected by smudges or scratches on cuvettes.
4. Using second dilution (clear solution), place cuvette on carrier block, raise block. Take RBC, MCV and HCT reading. Record. Recheck results X3.
   Note: Read within 5 minutes after preparation of sample.
   CAUTION: To prevent cross-contamination, before running an RBC/HCT/MCV test following a WBC/HGB test, run one rinse count with fresh diluent. Blot probe thoroughly.
5. Run 2 counts of detergent and one rinse count.
   * End of day procedure:
     a. Run 5 counts of deproteinizing solution.
     b. Backflush all fluid using clean cuvette.
     c. Run 5 counts of detergent.
     d. Back-flush all detergent.
     e. Run 5 counts of distilled water. Leave probe immersed in water.

Related Information

The instrument performs the tests quickly and easily. The red and white cell counts are obtained by electrical conductivity detection. Hemoglobin is measured by an optical absorbance test and the hematocrit by electronic determination of the total volume of the cells counted. Using the measured values for RBC and HCT, the instrument automatically calculates the mean corpuscular volume.

The red blood cells (erythrocytes) contain hemoglobin, the essential oxygen carrier of the blood. An increase in red cells may indicate hemoconcentration (insufficient water in the blood), or polychthemia, which is a condition characterized by a persistently elevated red cell count. A reduction on the red cells may come from hemorrhage or one of the anemias.

White blood cells (leucocytes) are important in the defense of the body against invading microorganisms, since they destroy most harmful bacteria. An increase in the count is usually seen in infections. It may also be observed in other conditions including emotional upsets, blood disorders,and anesthesia. A decrease in the white blood cells may be seen in blood dyscrasias, overwhelming infections, and drug and chemical toxicity.

The hematocrit test measures the relative volume of cells and plasma in the blood. In anemias and after hemorrhage the hematocrit reading is lowered; in polycythemia and dehydration it is raised.

Hemoglobin, the essential oxygen carrier of the blood, is found within the red blood cells and is responsible for the red color of the blood. The hemoglobin is decreased in hemorrhage and anemias and increased in hemoconcentration and polycythemia. The hemoglobin and red cell count do not always rise or fall equally. This fact is often important in differential diagnosis of anemias. In iron deficiency (microcytic) anemia, hemoglobin is reduced more than the red blood count. In pernicious anemia, the red cell count is reduced more than hemoglobin.

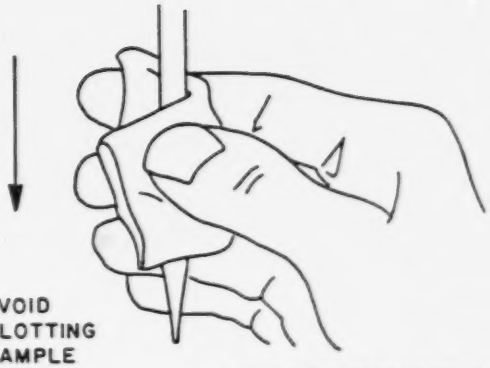
The mean or average size (mean corpuscular volume) of the individual erythrocyte in cubic microns may be calculated from the volume and number of erythrocytes in a given quantity of blood. If the cells are larger than normal , the condition is called macrocytosis, and if associated with anemia, macrocytic anemia. If the cells are normal in size, they are called normocytic, and if associated with anemia, normocytic anemia.

Expected Values

WBC	Males	3.8	-9.8	HCT %	Males	36.1	-48.5
	Females	3.6	-9.5		Females	35.0	-45.2
RBC	Males	3.92	-5.55	MCV	Males	82	-99
	Females	3.74	-4.94		Females	83	-100
HGB	Males	11.6	-16.4				
	Females	11.2	-14.6				

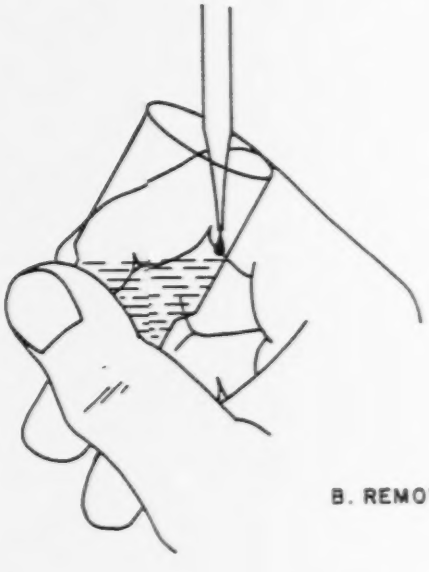
Aspirated Sample

A. RECEIVING DILUTION ON WALL OF VIAL.



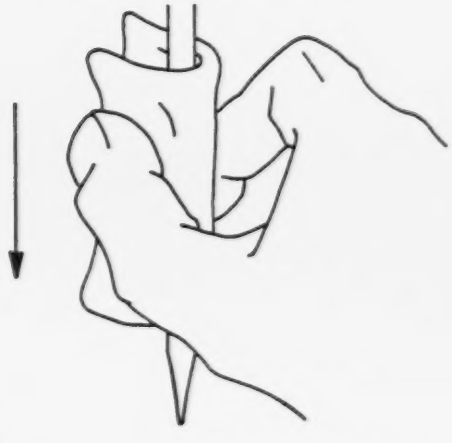
AVOID BLOTTING SAMPLE FROM TIP END.

A. WIPING FRONT AND BACK.



B. REMOVING LAST DROP.

Dispensing Dilution



B. WIPING SIDES.

Wiping Pipette Tip

ASSIGNMENT

Activity:

1. Practice obtaining a WBC/RBC/HCT/HGB/MCV determination using the Hycel counter 555. Record your results on a laboratory report form.

Vocabulary - define the following:

1. Hematology
2. Dyscrasia
3. Lysis
4. Polycythemia
5. Pernicious anemia
6. Microcytic anemia

Questions:

1. Why is the proper care of the Hycel counter 555 of such importance?

2. What is the hematopoietic system and what does it include?

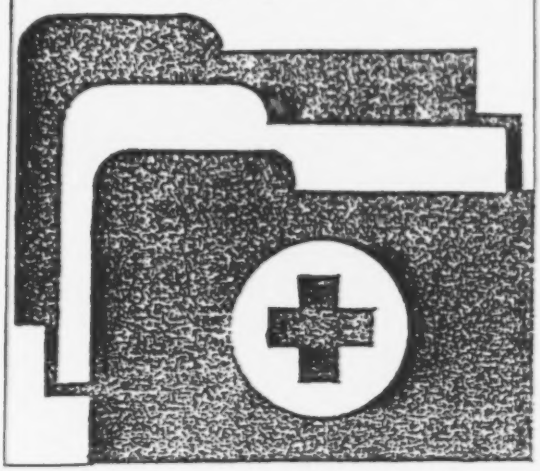
3. Contrast erythrocytes and leukocytes (include origin, size, normal amount, functions, one disease due to decrease and one due to increase in both types of cells).

INSTRUCTOR CHECKLIST: *Performing a RBC/HGB/HCT/and MCV using the Hycel counter 555.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled necessary equipment and supplies.*		
2. *Warmed-up and back-flushed counter. (Completed start of day routine)*		
3. *Correctly prepared RBC and WBC dilution.*		
4. *Added lysing and hemoglobin solution to correct dilution.*		
5. *Took hemoglobin reading after 3 minutes.*		
6. *Raised carrier and took WBC reading.*		
7. *Rinsed counter with diluent.*		
8. *Wiped pipette correctly.*		
9. *Made RBC/HCT/MCV determination on correct dilution.*		
10. *Cleaned machine. (Complete end of day routine).*		
11. *Recorded test results.*		
12. *Cleaned up and relaced equipment.*		

***All steps must be rated acceptable**

Health Assistants



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A LEARNING GUIDE

TASK: PERFORM CHOLESTEROL TEST USING THE UNITEST SYSTEM

PURPOSE: IN VARIOUS DISEASE STATES THE CHOLESTEROL CONCENTRATION IN THE SERUM MAY BE RAISED OR LOWERED.

TASK: PERFORM CHOLESTEROL TEST USING THE UNITEST SYSTEM

Terminal Performance Objective

Given a Unimeter 300, a unitest reagent kit, a blood sample, and other necessary equipment and supplies, determine the cholesterol level of the sample with 100% accuracy.

Safety Factors

1. Controls must be kept refrigerated.
2. Use extreme caution when handling body fluids to avoid possible contamination.
3. Never use reagents from one unitest kit with another.
4. The activator contains sulfuric acid and glacial acetic acid. These materials are POISONS and CORROSIVES. They should not be taken internally or in any way come in contact with the body. If left uncapped, they will absorb water, thus adversely affecting the test results.

Equipment and Supplies

Unimeter 300
Unitest cholesterol reagent kit
Unitest system automatic pipette
Unimeter calibration kit
Biotrol N control / Blood serum - red top collection tube

Performance Guide

1. Turn the Unimeter on and allow 30 minutes warm-up time. Insert the cholesterol meter scale. Place the zero blank in the optical module. Adjust the meter zero knob to align the needle over the meter zero line on the meter scale.
2. Remove the green cap from the cholesterol unitube.
3. Place a new tip on the unitest system automatic pipette. Tilt the tube containing the patient's serum. Push the plunger of the automatic pipette past the first stop, down to the second stop and insert the tip into the sample. Slowly release the plunger of the pipette to its original position. Wipe serum from the outside of the tip with a lint-free tissue. (Be careful not to touch end of tip.)
4. Insert the pipette tip into the unitube below the surface of the reagent solution. Dispense the sample into the unitube by pushing the pipette plunger down to the second stop. Without allowing the tip to leave the mixture, refill the tip and dispense again. Repeat this rinsing four times. Discard the tip.
   Note: If you are unsure if you added your sample DO NOT ADD ANOTHER SAMPLE. Discard unitube.
5. Cap the unitube and mix be inverting five times.
6. Add 0.5 ml cholesterol activator to the unitube, tilting the tube slightly to allow the activator to flow slowly down the side of the unitube. WARNING: This reaction generates heat. Add the activator to the unitube slowly.

CAUTION: Keep activator bottle tightly capped when not in use to prevent absorption of water.(Dropper should be stored in a small vial and not left in the activator.)

7. Wait 15 seconds after adding activator and then cap the unitube and mix by inverting five times. Allow the unitube to stand at room temperature for exactly 2 minutes.
8. Carefully wipe the unitube clean with a lint-free tissue.
9. With the water blank in place, set the unimeter needle to the black "calibrate" line on the cholesterol meter scale. Remove the water blank and insert the unitube. Read and record the test results. Discard the unitube. The final color will fade. The unitube should be read immediately following the two minute incubation.

NOTE: For best results the water blank should be kept clean at all times. Remove fingerprints and smudges with a lint-free tissue.

Related Information

Cholesterol belongs to a complex group of compounds called sterols. Sterols are found in all living matter and are absorbed from the intestinal tract. This sterol is found in the blood as free cholesterol and cholesterol esters. Approximately 70 percent of the cholesterol in plasma is esterified. The remaining 30 percent is in the free state. Total Cholesterol includes both free cholesterol and cholesterol esters.

The synthesis of steroid hormones depends mainly on cholesterol, and the metabolism of fatty acids is partially dependent on it. The fatlike properties of cholesterol classify is as a lipid. Lipids are organic compounds that are insoluble in water but soluble in organic solvents.

Cholesterol is found in brain tissue, blood and bile. It is synthesized primarily in the liver, and some of it is formed when erythrocytes are destroyed. Recent studies have shown that cholesterol is linked to a disease known as atherosclerosis, or hardening of the arteries caused by the formation of plaques within the arterial walls.

A clinician will often request lipid analyses to evaluate pancreatic disease, steatorrhea, liver disease, diabetes, hypothyroidism and hyperthyroidism. Frequently this request includes the determination of total cholesterol and sholesterol esters. These ayalyses may be of clinical interest because the percentage of esters is significant in the evaluation of some diseases.

Most laboratory methods involve the extraction of cholesterol with an organic solvent from serum or plasma. The extract is then treated with a color-developing reagent. The absorbance of the resulting reaction misture is determined in a spectrophotometer and then compared against a standard of known concentration.

Preparation of the patient

Food and beverage restrictions before obtaining the blood sample vary among laboratories. Because the ingestion of large amounts of cholesterol during the 12 hours preceding the test may affect the results, a fasting state is often required.

Expected Values

The following range may be expected for fasting adults using the Unitest procedure: 125- 285 mg/dl.

Note: The normal level for cholesterol (less than 200 mg/dl) and triglycerides (less than 100 mg/dl)are difficult to establish, because conditions such as coronary atherosclerosis, dietary hypercholesterolemia and obesity, which are common in the United States, cause frequent elevations that may be considered a normal pattern.

Implications

Once hyperlipidemia has beenidentified, the cornerstone of treatment is dietary alteration. The goal is to attain and maintain an ideal weight.

ASSIGNMENT

Activity:

1. Practice obtaining a cholesterol determination using the Unimeter 300. Record your results on a laboratory report form.

Vocabulary - define the following:

1. Cholesterol
2. Lipids
3. Atherosclerosis
4. Spectrophotometer
5. Hypercholesterolemia
6. Steatorrhea

Questions:

1. Where is cholesterol found?
2. What is the function of cholesterol in the body?
3. Of what significance is cholesterol in relation to coronary artery disease?
4. What foods are identified as having a high cholesterol content?
5. What recommendations are made by the American Heart Association in regard to heart disease?
6. What is the normal blood cholesterol range?

INSTRUCTOR CHECKLIST: *Performing a cholesterol test using the unitest system.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled necessary equipment and supplies.*		
2. *Warmed-up and checked calibration of Unimeter.*		
3. *Correctly pipetted sample and added to unitube.*		
4. *Mixed contents of unitube.*		
5. *Carefully added cholesterol activator to unitube.*		
6. *Capped unitube after 15 seconds and mixed contents.*		
7. *Kept unitube at room temperature for 2 minutes.*		
8. *Wiped unitube clean of smudges with lint-free tissue.*		
9. *Set unimeter with water blank.*		
10. *Inserted unitube and read results.*		
11. *Recorded results of test.*		
12. *Cleaned and replaced equipment.*		

***All steps must be rated acceptable**

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A LEARNING GUIDE

TASK: PERFORM HEMOGLOBIN TEST USING THE UNITEST SYSTEM

PURPOSE: IT IS THE SIMPLEST MEANS OF DETECTING THE EXISTENCE AND DEGREE OF ANEMIA AND OF JUDGING THE EFFECT OF TREATMENT OF ANEMIC CONDITIONS.

TASK: PERFORM HEMOGLOBIN TEST USING THE UNITEST SYSTEM

Terminal Performance Objective

Given a Unimeter 300, a unitest reagent kit, a blood sample, and other necessary equipment and supplies, determine the hemoglobin concentration of the sample with 100 % accuracy.

Safety Factors

1. Controls must be kept refrigerated.
2. Use extreme caution when handling body fluids to avoid possible contamination.
3. Never use reagents from one unitest kit with another.
4. The unitube reagent contains cyanide - a POISON. DO NOT take internally.

Equipment and Supplies

Unimeter 300
Unitest hemoglobin reagent kit
Unitest system automatic pipette
Unimeter calibration kit
Biotrol H control / Whole blood- purple top collection tube

Performance Guide

1. Turn the unimeter on and allow 30 minutes warm-up time. Insert the hemoglobin meter scale. Place the zero blank in the optical module. Adjust the meter zero knob to align the needle over the meter zero line on the meter scale.
2. Remove the yellow cap from the hemoglobin unitube.
3. Place a new tip on the unitest system automatic pipette. Tilt the tube containing the patient's well mixed whole blood. Push the plunger of the automatic pipette down to the first stop only and insert the tip into the sample. Slowly release the plunger of the pipette to its original position. Wipe blood from the outside of the tip with a lint-free tissue. (Be careful not to touch end of tip.)
4. Insert the pipette tip into the unitube, below surface of the reagent solution. Dispense the sample into the unitube by pushing pipette plunger down past the first stop to the second stop. Without allowing the tip to leave the mixture, refill tip and dispense again. Repeat this rinsing four times. Discard the tip.
5. Cap the unitube and mix by inverting five times. Allow to stand at room temperature for 30 seconds.
6. Carefully wipe the unitube clean with a lint-free tissue.
7. With the water blank in place, set the unimeter needle to the black "calibrate" line on the hemoglobin meter scale. Remove the water blank and insert the unitube. Read and record the test result. Discard unitube. The final reaction will remain stable for at least one hour. (For best results the water blank should be kept clean at all times.)

8. Clean up area.

Alternate Procedure - Micro-puncture

This simplified procedure, using capillary blood from a finger, heel or ear lobe puncture, may be especially useful when only a hemoblobin test is needed. Lnace the puncture area well so that the blood flows freely. Do not "milk" the wound to obtain blood; this will cause dilution of the blood with tissue fluid resulting in a falsely low hemoglobin value.

NOTE:

When performing the alternate procedure, work quickly to avoid clotting of the blood in the capillary tube.

a. After lancing, place the end of the capillary tube (provided in kit) into the drop of blood. The tube will fill automatically.
b. Examine the filled tube for bubbles. If bubbles are present, discard the tube, take a new tube and start again until a filled tube with no bubbles is obtained.
c. Carefully wipe the outside of the filled capillary tube clean with a lint-free tissue. Do not touch either end of the tube while cleaning.
d. Place the filled capillary tube in the Hemoglobin unitube and replace the yellow cap. Shake vigorously until all blood is out of the capillary tube.
e. Carefully tilt the unitube to cause the capillary tube to adhere to side of the unitube at the top (nearest the cap). Be sure capillary tube is not in the lightpath. Allow the tube to stand at room temperature for 30 seconds.
f. The unitube is now ready to be read.

Related Information

Hemoglobin is found within the red blood cells and is responsible for the red color of the blood. It is composed of hematin, an iron constituent, and globulin, a protein constituent. The hemoglobin serves as a vehicle for the transportation of oxygen and carbon dioxide. It has the ability to form a loose union with oxygen and becomes oxyhemoglobin. Its main function is the transportation of oxygen from places of high-oxygen pressure (lungs) to places of low-oxygen pressure (tissues). Another function of the hemoglobin is the transportation of carbon dioxide cell waste from the tissues to the lungs.

DIAGNOSTIC IMPORTANCE OF HEMOGLOBIN ESTIMATION

The main purpose of hemoglobin estimation is in conjunction with anemia. The hemoglobin is decreased in hemorrhage and anemias and increased in hemoconcentration and polycythemia vera. The hemoglobin and red cell count do not always rise or fall equally. This fact is often important in the differential diagnosis of anemias. In iron deficiency (microcytic) anemia, hemoglobin is reduced more than the erythrocyte count. In pernicious anemia, the erythrocyte count is reduced more than the hemoglobin. The quantitative estimation of hemoglobin is less tedious and, if reasonably accurate, usually more helpful than an erythrocyte count. It offers the simplest means of detecting the existence and degree of anemia and of judging the effect of treatment on anemic conditions.

Normal Values

Hemoglobin normals for men are 14 to 18 gm. per 100 cc. of blood (90 to 110 percent); for women they are 12 to 16 gm. per 100 cc. of blood (80 to 100 percent). For children, normals at birth are 20 to 22 gm., dropping gradually to 12 to 14 gm. at about 12 years.

Methods of Measurement

In general, the methods used for measuring hemoglobin are classified as direct and indirect. Direct methods measure the red color of the blood; for indirect methods, the hemoglobin is first converted into one of several compounds, such as acid hematin. The measurement is done be comparing the unknown sample with a standard. The method of comparison may be visual or photoelectric; the latter is considerably more accurate.

ASSIGNMENT

Activity:

1. Practice obtaining a hemoglobin determination using the Unimeter 300. Record your results on a laboratory report form.

Vocabulary--define the following:

1. Hemoconcentration
2. Hematin
3. Globulin
4. Anemia

Questions:

1. Where is hemoglobin found?
2. What is the main function of hemoglobin?
3. What is the diagnostic importance of hemoglobin estimation?
4. Of what is hemoglobin composed?
5. Why is a diet rich in iron essential for a person who has anemia?
6. State the foods rich in available iron.
7. Give hemoglobin normals for:
   a. Men
   b. Women
   c. Infants at birth
   d. Children

INSTRUCTOR CHECKLIST: *Performing a hemoglobin test using the Unitest system.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled necessary equipment and supplies.*		
2. *Warmed-up and checked calibration of Unimeter.*		
3. *Correctly pipetted blood sample.*		
4. *Mixed sample with proper reagent.*		
5. *Kept unitube free of smudges.*		
6. *Set unimeter with water blank.*		
7. *Inserted unitube and read results.*		
8. *Recorded results.*		
9. *Cleaned and replaced equipment.*		

***All steps must be rated acceptable**

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A LEARNING GUIDE

TASK: PERFORM BLOOD GLUCOSE TEST USING THE UNITEST SYSTEM

PURPOSE: THIS TEST IS PERFORMED TO DISCOVER WHETHER THERE IS A DISORDER OF GLUCOSE METABOLISM.

TASK: PERFORM BLOOD GLUCOSE TEST USING THE UNITEST SYSTEM

Terminal Performance Objective

Given a Unimeter 300, a unitest reagent kit, a blood sample, and other necessary equipment and supplies, determine the glucose level of the sample with 100% accuracy.

Safety Factors

1. Controls must be kept refrigerated.
2. Use extreme caution when handling body fluids to avoid possible comtamination.
3. Never use reagents from one unitest kit with another.
4. The color developer is POISON and CORROSIVE.

Equipment and Supplies

Unimeter 300
Unitest blood glucose reagent kit
Unitest system automatic pitette
Unimeter calibration kit
Biotrol N control / Blood serum - red top collection tube

Performance Guide

1. Turn the Unimeter on and allow 30 minutes warm-up time. Insert the glucose meter scale. Place the zero blank in the optical module. Adjust the meter zero knob to align the needle over the meter zero line on the meter scale.
2. Remove the red cap from the blood glucose unitube.
3. Add 2 drops glucose chromogen to the unitube. (Do not allow tip of dropper bottle to touch top of unitube.)
4. Add 2 drops glucose enzyme to the unitube. (Do not allow tip of dropper bottle to touch top of unitube.)
5. Place a new tip on the unitest system automatic pipette. Tilt the tube containing the patient's serum (or plasma). Push the plunger of the automatic pipette down to the first stop only and insert the tip into the sample. Slowly release the plunger of the pipette to its original position. Wipe serum (plasma) from the outside of the tip with a lint-free tissue. (Be careful not to touch end of tip).
6. Insert the pipette tip into the unitube, below surface of the reagent solution. Dispense the sample into the unitube by pushing pipette plunger down past the first stop to the second stop. Without allowing the tip to leave the mixture, refill the tip and dispense again. Repeat this rinsing four times. Discard the tip.
7. Cap the unitube and mix by inverting five times. Place the unitube in the incubator for 15 minutes.
8. After incubation, remove unitube cap. Add 2.0 ml glucose color developer to the unitube.
9. Cap the unitube and mix by inverting five times.

10. Carefully wipe the unitube clean with a lint-free tissue.
11. With the water blank in place, set the unimeter needle to the black "calibrate" line on the blood glucose meter scale. Remove the water blank and insert the unitube. Read and record the test results. Discard the unitube. The final reaction color will remain stable for 20 minutes. (For best results the water blank should be kept clean at all times.)
12. Clean up area.

Related Information

Chemical analysis of blood for glucose is one of the most frequently performed tests in the clinical laboratory. Glucose (dextrose) is the essential energy-producing end product of carbohydrate digestion. It is finally oxiidzed to yield energy for cells. Glucose carried in the blood is known as blood sugar.

Absorption of glucose into the bloodstream usually occurs in the small intestine. Excess glucose is either stored in the liver as glycogen or converted to fat. The hormones insulin and glucagon are secreted by the pancreas and play significant roles in carbohydrate metabolism.

Insulin promotes the transformation of glucose into glycogen and utilization of glucose by the cells. Glucogon promotes the formation of glucose from glycogen. Diabetes Mellitus is a serious disorder of carbohydrate metabolism resulting from a deficiency in insulin production. As a result, the diabetic has poor glycogen synthesis and poor glucose oxidation. In addition, the diabetic suffers from an incomplete oxidation of fat (ketosis). This causes ketone bodies (acetone, B-hydrobutyric acid, and acetoacetic acid) to accumulate in the blood.

Elevated blood sugar values are of interest to the clinician as an aid in the diagnosis of diabetes mellitus, overactive thyroid, and disorders of the pituitary and adrenal glands. Decreased levels may reflect an overdose of insulin, hypothyroidism, and diseases of the pituitary and adrenal glands.

Collection of Specimens

Blood glucose levels are clinically significant when the patient has been fasting. Ingestion of food prior to collection of the blood specimen will influence the results and may render them useless.

Specimens are usually collected prior to breakfast and are called fasting blood sugars (FBS). FBS determinations may be used in the diagnosis of diabetes mellitus.

Expected values

The normal adult range is 60mg/dl to 120mg/dl.

ASSIGNMENT

Activity:

1. Practice performing a blood glucose test using the Unimeter 300. Record your results on a laboratory report form.

Vocabulary - define the following:

1. Diabetes mellitus
2. Blood sugar
3. Islets of Langerhans
4. Insulin
5. Ketosis

Questions:

1. What is meant by a fasting blood sugar?
2. Of what importance is the blood sugar determination?
3. What are the causes of an elevated blood sugar?
4. What may cause a decrease in blood sugar level?
5. What is the normal blood sugar range?
6. If Blood were drawn an hour after a high carbohydrate meal, what results would you expect?

INSTRUCTOR CHECKLIST: *Performing a blood glucose test using the Unitest system.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled necessary equipment and supplies.*		
2. *Warmed-up and checked calibration of Unimeter.*		
3. *Added proper reagents to blood glucose unitube.*		
4. *Pipetted sample and added to unitube.*		
5. *Mixed and incubated contents of unitube for the required time.*		
6. *Added color developer and mixed.*		
7. *Set unimeter with water blank.*		
8. *Kept unitube free of smudges.*		
9. *Inserted unitube and read results.*		
10. *Recorded results of test.*		
11. *Cleaned and replaced equipment.*		

***All steps must be rated acceptable**

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A LEARNING GUIDE

TASK: PERFORM PROTHROMBIN TIME TEST USING THE COAGULATION UNIMETER 500

PURPOSE: TO EVALUATE ORALLY ADMINISTERED ANTICOAGULANT THERAPY.

TASK: PERFORM PROTHROMBIN TIME TEST USING THE COAGULATION UNIMETER 500

Terminal Performance Objective

Given a Coagulation Unimeter 500, a prothrombin time test kit, a blood sample, and other necessary equipment and supplies, determine the prothrombin time of the sample with 100% accuracy.

Safety Factors

1. Controls must be kept refrigerated.
2. Use extreme caution when handling body fluids to avoid possible contamination.
3. The PT reagent contains phenol which is a POISON. Do not take internally. Refrigerate.

Equipment and Supplies

1. Coagulation Unimeter 500
2. One-stage prothrombin time test kit
3. Automatic pipette
4. Coagulation control / Blood plasma - Blue top collection tube

Performance Guide

1. Turn the Coagulation Unimeter on and allow 30 minutes warm-up time. At the end of warm-up time the decimal point in the timer display should be lighted continuously. Make sure reaction chamber is empty. Depress reset switch - decimal point should extinguish and relight in about 3 seconds. Time display should indicate zero time (00.0). Using a sweep second hand, check accuracy of the timer. Touch bottom of reaction chamber with the eraser end of a pencil - the timer should start indicating elapsed time in seconds. Remove pencil as soon as the timer starts. When timer indicates "60.0" seconds, put the pencil again into the reaction chamber. The timer should indicate the total elapsed time in seconds and should be the same as indicated by the clock. (These steps show if the timer is operating properly).
2. Reconsitute coagulation control as follows:
   (a) Remove seal from coagulation control vial.
   (b) Add 1.0ml distilled water
   (c) Replace cap and agitate gently until material is completely dissolved.
3. Place reaction cuvettes in the incubator (two for coagulation control and two for each patient).
4. Pour approximately 1 ml of coagulation control and 1 ml of each patient's plasma into separate reaction cuvettes. Place these in the 37°C incubator for at least 3 minutes and no longer than twenty minutes.
5. Mix thromboplastin (green cap) by inverting 3 times.
6. Put a new disposable tip on automatic pipette. Pre-wet with thromboplastin. Fill tip with thromboplastin and dispense into a reaction cuvette. Repeat this operation for each reaction cuvette. Discard disposable tip.

7. Put a new disposable tip on automatic pipette. Pre-wet tip with calcium chloride (blue cap). Fill tip with calcium chloride and dispense into reaction cuvette already filled with thromboplastin. Repeat this operation for each reaction cuvette. Discard disposable tip.
8. Incubate reaction cuvettes containing thromboplastin-calcium chloride at least 3 minutes.
9. Transfer incubated reaction cuvette containing thromboplastin-calcium chloride mixture to the instrument reaction chamber.
10. Attach new tip to automatic pipette. Pre-wet and then fill tip with incubated coagulation control. Wipe off outside of tip with a lint-free tissue. DO NOT touch the opening at the end of tip.
11. Gently insert filled disposable tip into opening of reaction chamber. Continue to hold automatic pipette and push reset button on front of instrument. Lighted decimal point in the digital readout will turn off; timer will reset to zero.
12. When decimal point relights, dispense coagulation control into reaction chamber at smooth moderate speed. Timer will start automatically and stop when the clot has formed, indicating elapsed time. Leave disposable tip in top of reaction chamber throughout this step.
13. When timer stops, record the time shown on digital timer. This is the prothrombin time of the coagulation control. Discard the used disposable tip and used reaction cuvette. Confirm coagulation test result by repeating test using second incubated thromboplastin-calcium chloride cuvette. Compare the two reaction times, if they are within one-half second of each other and are both between 10 and 14 seconds, the test system is operating properly.
14. Repeat test using each patient's plasma. Run in duplicate to insure accuracy.

NOTE: The plasma should be used within 30 minutes of its preparation unless refrigerated. If refrigerated, it should be used within 2 hours.

Related Information

This is an indirect test of the clotting ability of the blood. Prothrombin is converted to thrombin in the clotting process. When the prothrombin level of the blood is lower than normal, it is believed that the clotting tendency of the blood vessels is diminished. The prothrombin content of the blood is lowered in liver diseases, hypothrombinemia of infants, vitamin K deficiency, and following drug therapy. The vast majority of cases of low blood prothrombin results from the administration of Dicumarol or similar drugs. These substances are given to reduce the clotting tendency of the blood and thus avoid thromboembolic phenomena.

This test is often done daily during the acute stages of myocardial infarction, and accurate results are needed promptly in order to enable the physician to determine the size of the next dose of anticoagulant.

The one stage prothrombin test is commonly used to evaluate orally administered anticoagulant therapy (coumarin type drugs). Although the test does not actually measure the therapeutic or antithrombic range of an anticoagulant drug, it is an indicator of the safety from bleeding and may be regarded as a quantitative measure of the prothrombin complex. The patient need not be in a fasting state.

Drugs

The prothrombin time may be reduced by several groups of drugs including:

- Antibiotics
- Hydroxyzine (Vistaril)
- Salicylates, including Aspirin
- Sulfonamides

Expected Values

Normal prothrombin time range is 10 to 14 seconds.

ASSIGNMENT

Activity:

1. Practice obtaining a prothrombin time using the Coagulation Unimeter 500. Record your results on a laboratory report form.

Vocabulary - Define the following:

1. Coagulation
2. Myocardial Infarction
3. Thromboembolism
4. Salicylate

Questions:

1. What is the purpose of anticoagulant therapy?

2. Why is it important for a person receiving anticoagulant therapy to be monitored at frequent intervals?

3. Differentiate between blood plasma and blood serum.

4. If a patient's prothrombin time is not within normal limits, what must be done?

5. Of what significance is Vitamin K in regard to blood clotting?

INSTRUCTOR CHECKLIST: *Performing a prothrombin time test using the coagulation unimeter.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled necessary equipment and supplies.*		
2. *Warmed-up and checked accuracy of unimeter timer.*		
3. *Reconstituted coagulation control and incubated for correct time.*		
4. *Correctly pipetted thromboplastin into reaction cuvettes.*		
5. *Pipetted calcium chloride into reaction cuvettes.*		
6. *Incubated cuvettes for 3 minutes.*		
7. *Placed cuvette in reaction chamber and inserted pipette with coagulation control.*		
8. *Reset instrument. Carefully dispensed coagulation control into cuvette.*		
9. *Read and recorded time shown on digital timer.*		
10. *Confirmed test by repeating.*		
11. *Repeated test in duplicate using patient's plasma.*		
12. *Recorded results.*		
13. *Cleaned up and replaced equipment.*		

***All steps must be rated acceptable**

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A LEARNING GUIDE

TASK: PERFORM VENIPUNCTURE

PURPOSE: IT IS PERFORMED WHEN A SPECIMEN OF BLOOD IS TO BE DRAWN FOR LABORATORY EXAMINATION

TASK: PERFORM VENIPUNCTURE

Terminal Performance Objective

Given a Veniform teaching model and other necessary equipment and supplies, perform a venipuncture within two attempts with 100% accuracy.

Safety Factors

1. Some patients are likely to experience syncope which could result in serious injury.
2. Prolonged application of the tourniquet can result in hemoconcentration (increase in the concentration of the formed elements caused by the lack of blood fluid).
3. Puncture of the outer wall of the vein and failure to enter the lumen can result in the formation of a hematoma (localized loss of blood from a vessel that results in a clot).

Equipment and Supplies

1. Venipuncture teaching model
2. Tourniquet
3. Vacuum-tube adapter, needle, and tubes
4. Alcohol sponges
5. Sterile dry gauze

Performance Guide

1. Assemble equipment and supplies. Inspect the patient's veins and select a suitable one for venipuncture.
2. Apply tourniquet. Cleanse skin with antiseptic. Have patient close fist.
3. Secure the vein by holding the arm with one hand and pulling back on the skin with the thumb. Enter the skin and vein with a single, direct puncture. The needle should be parallel to the vein, at a slight angle to the arm, and the bevel of the needle should face upward.
4. Using the appropriate vacuum tube, aspirate the required amount of blood, have patient open fist. Then release the tourniquet and withdraw the needle.
5. Apply sterile gauze with pressure to the puncture site, and instruct the patient to maintain pressure until the bleeding has ceased. Mix tubes by inverting. Label tubes.
6. Inspect site for bleeding. Apply dressing if necessary.

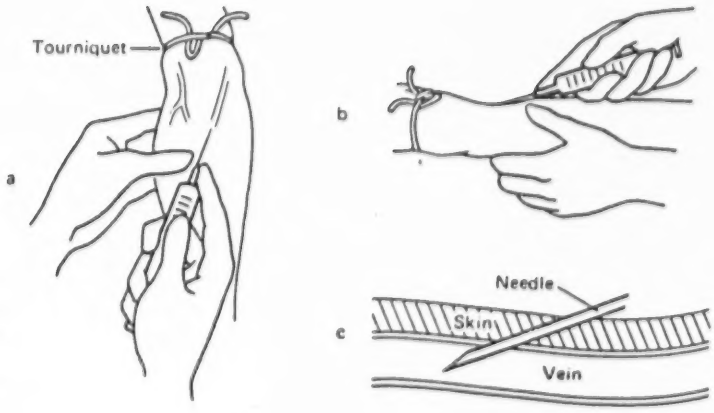
Related Information

The introduction of a hollow needle into a vein is called venipuncture. It is to be performed when a specimen of blood is to be drawn for laboratory examination. The basilic and median cubital veins of the forearm are used most frequently. The veins of the back of the hand may be used.

It is the responsibility of the person performing the venipuncture to prevent damage from occuring to the veins and to minimize patient discomfort or injury. Patients should always be approached in a confident, friendly manner. Blood collection should be made from a standing position, but the patient should be either in a comfortable sitting position or lying down.

When the veins of the arm are used, the arm should be extended and firmly suported. A tourniquet should be applied in the region of the biceps. The tourniquet should be just tight enough to restrict blood flow, but not tight enough to drastically reduce circulation. Its purpose is to fill up the veins with blood and make them easily palpable. The patient should open and close the fist to aid in filling the veins. The tourniquet should remain on until the blood is drawn, but must be released before the needle is withdrawn to avoid tissue damage to the patient.

All tubes should be labeled with the patient's identification and the purpose of the specimen.



Venipuncture technique. (*a*) Top view. (*b*) Side view. Note the angle of the syringe as the needle enters the blood vessel. (*c*) The bevel of the needle should face upward as it enters the vein.

ASSIGNMENT

Activity:

1. Practice a venipuncture on the teaching model.
2. Role play performing a venipuncture on another student.

Vocabulary - Define the following

1. Venipuncture
2. Tourniquet
3. Hematoma

Questions:

1. For what reasons is venipuncture performed?

2. Why should you avoid prolonged application of the tourniquet?

3. What should be done for a patient experiencing syncope?

4. How can hematoma be avoided?

INSTRUCTOR CHECKLIST: *Performing venipuncture.*

ACTIVITY	RATINGS*	
	Acceptable	Unacceptable
1. *Assembled necessary equipment and supplies.*		
2. *Prepared patient properly.*		
3. *Inserted needle correctly.*		
4. *Used appropriate vacutainer tube.*		
5. *Released tourniquet before withdrawing needle.*		
6. *Applied pressure, then dressing to puncture site.*		
7. *Mixed and labeled tubes.*		
8. *Cleaned up area.*		

*All steps must be rated acceptable